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A research-informed, school-based professional development workshop programme to promote dialogic teaching with interactive technologies

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ABSTRACT

The study reported in this article investigated the influence of a research-informed, school-based, professional development workshop programme on the quality of classroom dialogue using the interactive whiteboard (IWB). The programme aimed to develop a dialogic approach to teaching and learning mediated through more interactive uses of the IWB, through a model of active participation of students, collaborative knowledge-building, learning through inquiry and evaluating ideas. Ten professional development workshops based on video-stimulated discussions of practices were co-developed and conducted with an 'ambassador' within each of five school clusters. In total, 80 teachers from 15 schools, ranging from infant to secondary schools, participated. Data were collected through surveys, semi-structured interviews with teachers and ambassadors, teachers' posters created during workshop activities, lesson observations and a portfolio of dialogic classroom practices, mediated by the IWB. Findings strongly support the potential of this ambassador-led workshop model to involve teachers in developing their understandings of classroom dialogue and devising new approaches to support it. The research additionally confirms the potential of the IWB as a tool to support dialogic teaching.

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Professional development; classroom dialogue; dialogic teaching; interactive whiteboard; digital technology

Introduction

In this article we examine how a practitioner professional development (PPD) programme can enable the development of a dialogic pedagogy underpinned by use of a specific mediating technology, the interactive whiteboard (IWB). The IWB is embedded in UK education institutions; in the year of this study, about 92% of UK classrooms had an IWB, whilst Asia, North America and Mexico had similar levels of adoption (Futuresource 2014). Thus, the pedagogy of IWB use in classrooms is potentially important to several thousands of teachers and many more students. Research-informed professional development that considers how teaching might be improved in relation to such an almost ubiquitous tool therefore has a strong claim for potential impact.

The focus on the IWB in the PPD reported here derives from previous research indicating that it has specific affordances which, when exploited with a dialogic intention, have the potential to draw learners into new forms and 'spaces' of productive dialogue (Wegerif 2007). We will consider the

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 Supplemental data for this article can be accessed <http://dialogueiwb.educ.cam.ac.uk/evaluate/>

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question of why we have adopted a specifically dialogic focus a little later; for now, let us consider the IWB as a tool for learning. Previous work has argued that the affordances of provisionality, interactivity and multimodality, offered via the functionality of the IWB (e.g. through the contingent manipulation of text and images), provide powerful support for learners and teachers to engage more dialogically with lesson content (Jewitt 2006, Kennewell and Beauchamp 2007, Warwick *et al.* 2010). Importantly, we suggest that it is the development of pedagogy which determines specific perspectives on the affordances of a mediating technology, and hence its use. Such a conviction is founded on research undertaken over several years, in which we have shown how a framing of developing IWB use in the context of a detailed consideration and revision of pedagogy can open up opportunities for the generation, refinement, comparison and collective evaluation of new ideas in the classroom (Hennessy *et al.* 2007, Mercer *et al.* 2010, Warwick *et al.* 2010, Hennessy 2011). In such research we explored the technology's potential to provide opportunities for collaborative reasoning and knowledge-building, and we considered how practitioners can harness its distinctive affordances to create space, time and status for learner contributions, to challenge thinking and to offer responsive assistance.

A central argument for the potential importance of PPD founded on developing pedagogy in relation to technology use, therefore, is that it can both enhance classroom interaction for learning and, in consequence, lead to teachers employing technology in the classroom more effectively for learning than has previously been the case. This is crucial when considering both the structure and content of PPD that focuses on teaching and learning with technology, and for wider regional and national policy that determines how and where money might be spent in creating 'digital classrooms'.

The literature certainly raises questions concerning the impact that 'conventional' technology implementation in schools has had on pedagogy and student learning. In the first decade of the twenty-first century, for example, the 'Harnessing Technology' reports produced by Becta¹ in the United Kingdom pointed to a clear problem – 'the range of uses remains fairly limited and practitioners rarely realise the full benefits of technology in supporting learners' (Becta 2008, p. 23). Nearly 10 years later the Organisation for Economic Co-operation and Development (OECD), in their international comparative analysis of digital skills acquired by students and learning environments designed to develop these skills, stated that there are 'no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education' (OECD 2015, p. 3). They suggest that digital tools potentially offer a 'great opportunity for education', but caution that while 'technology can amplify great teaching ... great technology cannot replace poor teaching' (2015, p. 190). In the United States, studies such as that by Blanchard *et al.* (2016, p. 207) indicate that, even in the context of long-term PPD interventions in which some teachers 'used technology in ways to transform their roles and classroom practices', most teachers 'adopted technology in ways that improved their [administrative] efficiency and effectiveness'. With respect to the IWB, although researchers have reported that many teachers consider the technology to be a valuable, and in some cases indispensable, teaching resource (for example, Smith *et al.* 2006), others have pointed to the limited impact of IWB use in changing existing pedagogies (Kennewell and Beauchamp 2007, Moss *et al.* 2007, Somekh and 13 others 2007, Beauchamp and Kennewell 2010). This is despite the interactive functionality embedded in the tool.

Technology affordances and agency

We suggest it is the way in which potentially mediating technologies are employed by teachers that makes the difference in formal education. As Higgins *et al.* (2012, p. 3) report in their meta-analysis about the impact of the use of digital technology in schools on children's attainment, 'it is not whether technology is used (or not) which makes the difference, but how well the technology is used to support teaching and learning [...] This is the crucial lesson emerging from the research'.

To consider these ideas a little further, the technology-pedagogy relationship is certainly more subtle than some (particularly those involved with educational policy) might wish to accept (Lewin *et al.* 2009). If learning is viewed as a social process, then various forms of technology can be viewed

as mediating cultural tools (Säljö 1999, Wegerif and Dawes 2004, Crook 2007). Technological artefacts thus constitute mediational means (Wertsch 1998) with particular affordances (Gibson 1979) and constraints; in other words, they can facilitate or inhibit certain patterns of action. Indeed, as Hutchins (1997, p. 338) illustrates, an artefact as seemingly banal because a paper checklist can mediate cognitive activity, where mediation is seen as ‘a particular mode of organising behaviour with respect to some task’.

It seems that ‘one of the key roles claimed for (technology) in promoting learning is interactivity’, where interactivity relates to the expectation of increased and extended student engagement and contribution through ‘the orchestration of features of the classroom to provide potential and structure for action towards learning goals’ (Beauchamp and Kennewell 2010, pp. 759 and 760). The nature of this orchestration and the resulting interactivity seems crucial because, as we have already seen above, extensive yet ‘non-dialogic’ student interactions with technology seem to yield disappointing learning gains (Kennewell *et al.* 2008). We argue that whether technology acts in facilitating or constraining learning is dependent on the pedagogical intentions underlying their use.

In sum, our view is that, whilst it is undoubtedly true that technologies have such a constraining or facilitating effect derived from the affordances of their functionality, it is the way in which a teacher works with the affordances of a tool that defines whether it will be used effectively in teaching and learning. Thus, the teacher’s pedagogical stance is crucial; yet it seems clear that this has often not been attended to in PPD, which is often focused on developing teacher technology skills for use in the classroom. This is illustrated by a review for the OECD of the lessons learned from whiteboard initiatives internationally (Hennessy and London 2013) and evaluation studies of prominent UK technology-focused initiatives such as those by Moss *et al.* (2007) and Higgins *et al.* (2005). A rigorous evaluation of the national initiative to train all school teachers in England to use technology in teaching (Davis *et al.* 2009) confirmed that centralised skills-focused approaches were largely ineffective. Hence the focus here is on the interaction between pedagogical development and technology use in a school-based PPD programme.

Why a focus on a ‘dialogic’ pedagogy?

As we have indicated, in the PPD programme considered here we chose to focus teachers on the dialogic elements of their practice and on the ways in which the IWB might be used to develop dialogic interaction in the classroom. This focus derives from an emerging consensus concerning the forms of classroom dialogue which are productive for learning (for example, Howe and Abedin 2013, Littleton and Howe 2010, Michaels and O’Connor 2015). These centre around exchanging, evaluating and ultimately reconciling contrasting perspectives. Dialogue is thus distinguished from ‘just talking’ (Alexander 2008), with advocates of dialogic pedagogies maintaining that classroom dialogue is ‘central to the meaning making process and thus central to learning’ (Mortimer and Scott 2003, p. 3).

A dialogic pedagogy requires teachers and learners to actively comment and build on each other’s ideas, and construct shared interpretations and ‘common knowledge’ (Edwards and Mercer 1987). For the teacher, it emphasises the importance of open-ended higher-order questioning and the facilitation of explicit reasoning. For pupils, it means increased agency and participation in learning activity. The ethos in a ‘dialogic classroom’ is such that learners feel comfortable in expressing, justifying and revising their own points of view in relation to the perspectives expressed by others, and in taking extended turns in whole-class and group interactions (Mercer and Littleton 2007). This contrasts with an established culture of fact seeking (for example, Hakkarainen 2003) and a relationship that is founded principally on closed initiation–response–follow-up (Sinclair and Coulthard 1975), moving towards a situation in which pupil agency in learning is actively promoted.

Research suggests that the adoption of a dialogic pedagogy stimulates the development of pupils’ critical thinking and reasoning skills and self-regulated learning, and yields evidence of subject learning gains (Mercer *et al.* 2004, Rojas-Drummond *et al.* 2010). Systematic reviews of research (Howe and Abedin 2013, Clarke *et al.* 2016) found positive associations between student learning and the

expression of extended and cumulative responses in group interactions, where competing viewpoints were expressed and where resolution was sought between multiple perspectives. Based on such evidence, we see professional engagement with the ideas underlying a dialogic pedagogy as key to desirable pedagogical development, if not ‘transformation’, in many classrooms.

Given these wide-ranging considerations, the data collected around the PPD programme conducted with teachers are examined in this article in relation to the following research questions:

- Can a research-informed school-based professional development model promote dialogic teaching with interactive technologies?
- Does engaging in iterative design of the PPD model with ambassadors contribute to its manageable and sustainable implementation? What challenges arise?

A PPD model for developing dialogue using interactive technology

Our prior research, involving joint reformulation of theory with dialogic teachers, culminated in a theoretically informed, practical model and resource for school-based PPD (Hennessy *et al.* 2011). This was encapsulated in a published, multimedia PPD resource, *Developing Interactive Teaching and Learning using the Interactive Whiteboard* (Hennessy *et al.* 2014), co-authored by participating teachers. The book is accompanied by online multimedia resources,² including an open digital resource bank of annotated screenshots, video exemplars of dialogic classroom practice and flipchart templates for creating activities. Face-to-face workshop activities guide teachers through the PPD process. The materials are designed for use across phases (primary, middle and secondary schools) and subject areas. The workshop programme was piloted in a small number of schools and other institutions.

This earlier work emphasised both the technical functionality and affordances of the hardware and software, and the pedagogical context of its use. With this intention, the active involvement of teachers in developing their understanding of classroom dialogue, and in devising new IWB-based teaching approaches to support it, was seen as central. The approach is based on now well-established models of PPD that encourage critical reflection, peer learning, observation and feedback; which include concrete, experiential tasks and classroom trialling; and which focus on immediate teaching needs (Cordingley *et al.* 2003, Wells 2007, Twining *et al.* 2013). Such models offer opportunities to encourage, extend and structure professional dialogue, and to sustain PPD over time, enabling teachers to embed practice (Cordingley *et al.* 2003, Hennessy and London 2013). Even though there are other models of professional development – for example, professional learning communities (Mitchell and Sackney 2009) or mentoring (Zeichner 2010) – that equally promote critical reflection and peer learning, it is the focus on concrete, experiential tasks and classroom trialling to develop both technical and accompanying pedagogical skills that guided us towards this research-informed, ambassador-led PPD model. As Carlson and Gadio (2002, p. 119) make clear, ‘providing technical skills training to teachers in the use of technology is not enough. Teachers also need professional development in the pedagogical application of those skills to improve teaching and learning’; the researchers further state that ‘technology and teacher professional development in its use is best introduced in the context of [work that moves pedagogy from] teacher-centered, lecture-based instruction toward student-centered, interactive, constructivist learning’. They reinforce the key principles of teacher learning that should inform any programme, including being cooperative in nature, enabling the ‘trailing’ of technology use in curriculum contexts and subsequent sharing of perspectives and reflections. Wells (2014) also points out that necessitating and supporting problem-solving in classrooms through PPD interventions may embed professional learning and form one of the ways in which such interventions become sustainable.

Our approach links with what might be termed ‘reform-focused’ PPD, because the intention is to change, or at least modify, existing pedagogical practices (Garet *et al.* 2001, Wayne *et al.* 2008), often through an emphasis on opportunities to develop active learning and student agency. A key feature of our own model is that it involves the provision of a ‘well-specified professional development

program(me)' that draws on previous research activity (Borko 2004, p. 9), in this case with the intention of drawing on research-based multimedia resources to stimulate discussion, reflection and inquiry. This involves a cycle of teachers designing and trialling new dialogic teaching approaches that in turn become the focus of peer discussion. In particular, footage of unknown teachers allows viewers to experience and freely critique a wider range of practices, so that alternative pedagogical strategies can be compared and contrasted (Sherin 2007).

Also fundamental to our model is the recruitment of 'ambassadors' – teachers with an interest in dialogic teaching – who lead their colleagues from their own and neighbouring schools. These ambassadors liaised with the research team, scheduled and co-facilitated workshops with our researcher, and tailored the use of the multimedia resources to local needs. They helped to ensure school ownership of the programme and supported the spread of the approach within each cluster of linked local schools.

Whilst these features appear as elements within other PPD programmes, this model combines them, in particular emphasising the guided agency of teachers working together on issues related to their own classroom contexts. This shift towards developing agency through PPD is highlighted as important by Kennedy (2014), whilst an emphasis on collaborative practice is a consistent feature of professional learning in the literature (for example, Carlson and Gadio 2002, Labone and Long 2014).

The work reported here (funded by the Economic and Social Research Council [ESRC] Impact Acceleration Pilot Programme) devised and tested a strategy for rolling out the previously devised PPD model more widely and actively. This involved two workshops in each of five locations (school clusters), with teachers trialling new approaches in between them. Workshop 1 presented an overview of the programme and the resource book, and involved various video-stimulated activities. Teachers audited their practice using a 'Characteristics of Dialogue table'³ derived from our previous research (Warwick *et al.* 2011) and were shown video examples of dialogic teaching. Video-stimulated discussion led to an in-depth exploration of a 'Resource Bank' on our website and resulted in lesson planning in subject, year or Key Stage⁴ groups. Teachers were asked to design activities that intentionally built in opportunities for dialogue and required students to actively build on each other's ideas. Workshop 2 was a vehicle for sharing and reflecting on the teaching materials developed and trialled between the two workshops. Teachers were asked to comment on their own and their colleagues' concrete examples of dialogic teaching supported by the IWB. Further video examples of dialogic practice were shown and discussed. This workshop concluded with ideas for further development of their own dialogic practice and whole school approaches to dialogic teaching.⁵

Our approach shared some characteristics with the design-based iterative research approach outlined by Penuel *et al.* (2011), which emphasises a commitment to iterative, collaborative design concern; developing theory and knowledge related to both classroom learning and implementation; tailoring a model to a specific context; and developing capacity for sustaining change in systems. Our PPD model was iteratively designed in conjunction – and in response to facilitator experiences – with participants through a process of 'productive, mutual adaptation' (2011, p. 334) rather than a rigid notion of 'what works'. Workshops were co-developed with ambassadors in order to contextualise them adequately. While Workshop 1 was fairly standard across schools, Workshop 2 was flexibly adapted to the classroom materials that teachers sent in advance to ambassadors; the ambassadors drew on these to create a presentation for Workshop 2 which was further tailored in real time while it was running, based on additional materials that teachers brought along.

As the work progressed, evidence of teachers' developing understandings and practices was gathered through: a questionnaire survey to compare initial understanding and the degree of dialogic practice with teachers' perceived progress between workshops; interviews with ambassadors and teachers; teachers' posters created during workshop activities; two follow-up lesson observations; and portfolios of dialogic classroom practices with the IWB from teacher participants. Materials for wider dissemination were simultaneously developed through the portfolios and uploaded to our website.

Methods

Participants

Participants were recruited via existing links with local schools and a launch event, introducing the book and the PPD programme. Five designated clusters, which were able to identify a willing ambassador and could participate within the timescale of the study, were identified. Each cluster nominated its own ambassador based on a provided role description.

Ten PPD workshops were co-designed and co-delivered by the university research associate and ambassadors in five clusters. Two primary schools, one middle school and two secondary schools hosted the workshops. The vast majority (83%) of participants were KS2 or KS3 teachers (children aged 7 to 14); the rest were early years or KS1 teachers (children aged up to seven). Numbers of attendees per workshop ranged from nine to 24 and interludes between the two workshops ranged from 2 to 10 weeks.

A total of 80 participants (including the five ambassadors) from 15 schools, ranging from infant (one school) through primary (10 schools) to secondary (four schools), attended one or both workshops. Fifty-nine participants attended both workshops, and 16 of these (a convenience sample) were interviewed. British Education Research Association (BERA) Ethical Guidelines⁶ were followed and informed consent was obtained from all participants. Everyone involved was informed about the right to withdraw from the study at any time.

Data collection

The study employed a complex form of sequential mixed-methods design (Teddle and Tashakkori 2009), initially involving collection of some simple quantitative and qualitative data (surveys, Workshop 1 posters and recordings) providing baseline information in Phase 1. Various forms of qualitative data were collected in Phase 2 (Workshop 2 posters and recordings) and in follow-up Phase 3 (interviews and lesson observations). Table 1 presents an overview of the data collection phases, methods and purposes (research instruments are accessible on our website.⁷

An anonymous baseline survey was completed by 70 teachers prior to their participation in the project (key questions are duplicated later in Tables 3–5). Teachers' posters created during both workshops allowed an exploration of any pre-post shifts in their thinking; the choice of this method was based on the literature on concept mapping as a form of assessment of understanding (Novak and Gowin 1984). PPD workshop activities were audio-recorded to provide further data capturing teachers' discussions and, at Workshop 2, presentations of new activities created between workshops. Semi-structured interviews with groups or individuals (according to teachers' availability) were carried out a few weeks after the second workshop in order to explore teachers' understandings and perspectives in some depth. We also had the opportunity to extend our Phase 3 by observing two lessons about 10 school weeks after the second workshop in each case; resources did not permit any more than two but this offered a valuable addition to our data. Teachers submitted portfolio examples of dialogic artefacts in Phases 2 and 3, up to four months after the final workshop (detailed analysis of these was outside the scope of the study).

Trustworthiness of the approach (Lincoln and Guba 1985) was maximised through triangulation across methods and data sources, reliability measurement of researcher judgments, seeking of disconfirming evidence and corroborating concrete evidence of practices, participant validation through follow-up interviews and thick description of observed classroom contexts (space does not permit including the latter here).

Analysis

Surveys yielded quantitative and qualitative data and these were triangulated with the other data sources. A scheme for categorising qualitative answers to four survey items was developed inductively,

Table 1. Overview of data collection.

Purpose of data collection	Phases/types of data collection	Participants
To explore teachers' initial ideas about and understandings of dialogic teaching and the use of the IWB	Survey	70 (including five ambassadors)
Workshop 1: to record teachers' thoughts about 'classroom talk versus classroom dialogue', and auditing their own teaching practice	Phase 1: audio recordings	Four activities at nine workshops were audio recorded (10th workshop not recorded due to technical issues)
Workshop 2: to record rationale, benefits and challenges of applying dialogic teaching supported by the IWB	Phase 2: audio recordings	
Workshop 1: to record teachers' thoughts about 'classroom talk and dialogue'; auditing their own teaching practice	Phase 1: posters	30 posters (one poster/group of three or four teachers)
Workshop 2: to record benefits and challenges of applying dialogic teaching supported by the IWB (groups that were not audio recorded)	Phase 2: posters	10 posters
To collect concrete evidence of new dialogic lesson practices, confirming self-report data	Phases 2 and 3: portfolios of dialogic practice	37 teachers contributed 161 files of lesson material
Teachers: to revisit understanding of dialogic teaching post PPD programme; explore the programme's influence on teachers' practice, including development of teaching materials and perceived benefits for teachers	Phase 3: semi-structured interviews	16 participants: five ambassadors (individual interviews), 11 teachers (four individual + two group interviews)
Ambassadors: as above plus their role in the PPD programme and challenges faced		
To observe practice in action after the programme had formally ended and to analyse specific dialogic features of lessons	Phase 3: lesson observations: field notes, video and audio recordings, flipcharts, photographs, lesson plans	Two teachers: literacy and science lessons

Table 2. Analytic scheme for survey questions concerning understandings and uses of dialogic teaching: definitions of categories.

Weak/no understanding	Medium	Strong
Comments which refer only to talk, discussion, group work, pair work, wait time, open-ended tasks/questions, higher-order questions, teacher as facilitator, unelaborated reference to 'talk task', etc., moving learning forward, brainstorming	Comments which refer to some of the elements of dialogic teaching (e.g. rules for talk, collaboration, complementary roles within groups, 'talk for learning', striving to reach consensus through discussion, teacher learning with/from students, annotation on IWB during class discussion, use of images to stimulate discussion, listening to others, equality and free expression of views) but lack overall big picture/clarity/explicit responsivity	Comments which refer to responding to other people's ideas, debating, building on each other's ideas, co-construction of knowledge and learning, exploring different perspectives, challenging or disagreeing with others

allowing characterisation of teachers' understanding of dialogue, dialogic teaching and dialogic approaches to the IWB as strong, medium or weak (defined in Table 2).

All responses were independently categorised by two researchers, resulting in 93.5% agreement (100/107). Inter-coder reliability was calculated using Krippendorff's alpha and this returned a similar high figure of 0.94.

Semi-structured interviews were transcribed and then coded thematically through an iterative cycle of deductive and inductive coding (Teddle and Tashakkori 2009). Teachers' interviews were first coded according to four overarching categories based directly on the main interview questions about professional benefits ascribed by teachers to the PPD programme, examples of their improved practice, understandings of dialogic teaching after participation in the programme and about future plans of continuing the practice of dialogic teaching supported by the IWB. Within each category a number of themes emerged and were refined through close examination of the data. These were then validated

through systematic application across the data, and through purposefully seeking counterexamples and substantiation by concrete examples (see Silverman 2015). The final themes that emerged form the subheadings in the Findings and discussion section.

Ambassadors' interviews were also first coded deductively according to the four main interview questions – what they valued about their role; examples of improved practice; understanding of dialogic teaching after participation in the programme; challenges of their role and future plans for continuing their role. Secondary inductive coding again resulted in a number of themes emerging.

Findings and discussion

The findings are based on analyses integrating quantitative and qualitative data and are presented according to the overarching coding categories. Each category is further subdivided into emerging themes. Categories A–C address the first research question concerning whether and how the PPD model promotes dialogic teaching with technology and Category D addresses our questions about whether a cluster-based ambassador-led PPD model is sustainable and workable:

- Category A: baseline levels of understanding of dialogue, dialogic teaching and the role of the IWB
- Category B: understanding of dialogic teaching after participation in the PPD programme
- Category C: concrete examples of dialogic teaching supported by the IWB
- Category D: workability, challenges, sustainability, dissemination and future plans

The ambassador interviews focused especially on viability and sustainability of the model. Much from their accounts is integrated into Categories A–C where relevant, but there is a significant corpus of further data from this group that is presented under Category D, along with some additional comments from teachers. Note that all quotes derive from interviews unless otherwise indicated.

Category A: baseline levels of understanding of dialogue, dialogic teaching and the role of the IWB

Teachers' understandings of classroom dialogue

Analysis of the survey data showed that 56% (38/68 respondents to Question 4) of participating teachers agreed or strongly agreed that they were aware of the distinction between classroom dialogue and other forms of classroom talk prior to their participation in the PPD programme (13 teachers or 19% disagreed or strongly disagreed and the rest were neutral). However, there was an evident mismatch between teachers' self-assessment and their ability to demonstrate their knowledge. Qualitative analysis of a survey question concerning whether they could provide examples of their awareness of the distinction (coding understanding at three levels) indicated that many teachers actually lacked an understanding of any clear distinction. Thirty-one respondents elaborated on what they understood by dialogue; only six of these demonstrated a strong understanding of the distinction, a further seven showed moderate levels of understanding and 18 of the 31 showed weak understanding. Combined

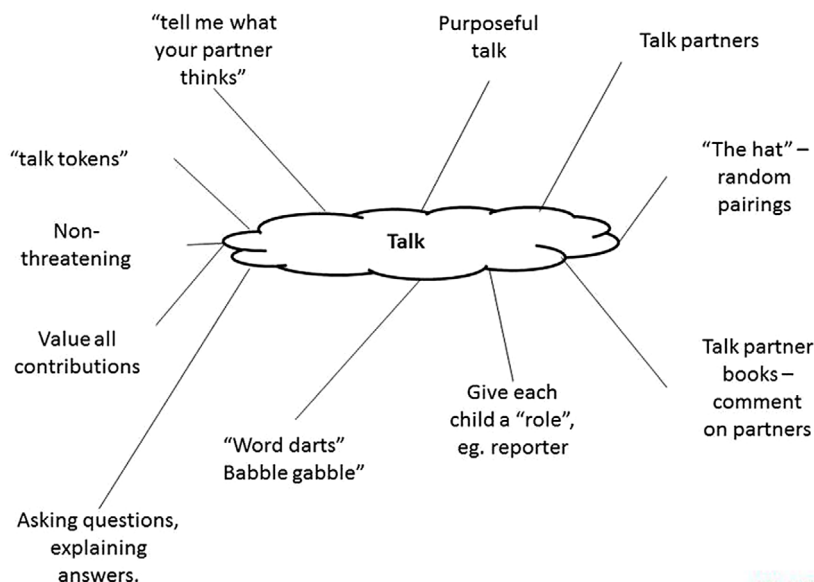
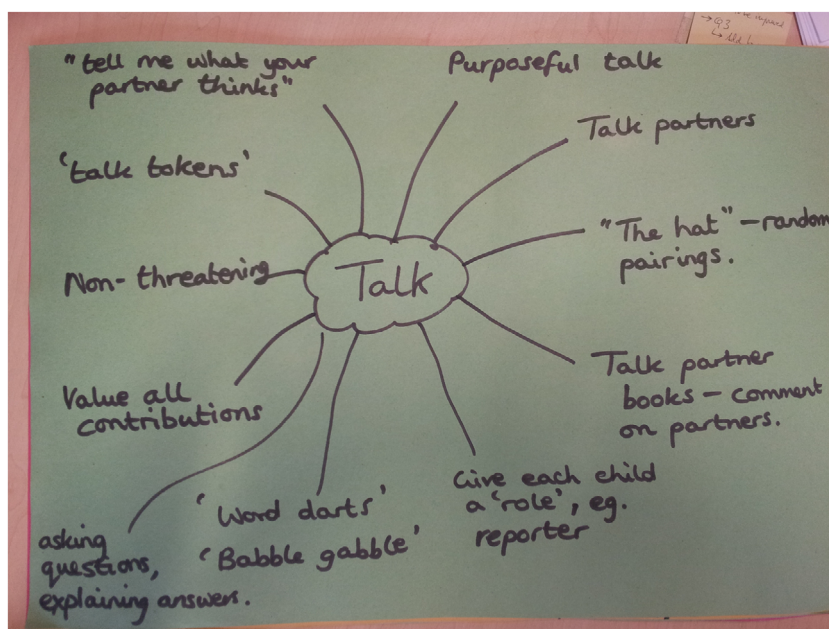
Table 3. Survey responses illustrating teachers' understandings of classroom dialogue (Question 4^a).

Level	Response
Weak	Chat to do with learning in the classroom Not led by one person
Medium	On-task discussion about the work/context they are doing. Two-way discussion where all views are listened to Input and discussions leading to collaborative learning between teachers and students and between students and their peers
Strong	Dialogue is sharing knowledge, and building on responses of other children. Dialogue shapes the lesson and provides feedback about what children know ... Is a conversation that usually involves two opposing perspectives or ideas that, through the conversation attempt to reach a resolution. Each utterance in the dialogue must give rise to a point or question in order for the dialogue to continue

^aQuestion 4. I am aware of the distinctions between classroom dialogue and other forms of classroom talk.
Strongly disagree / Disagree / Neither disagree nor agree / Agree / Strongly agree.
If you agree or strongly agree, please describe what you understand by 'dialogue'.

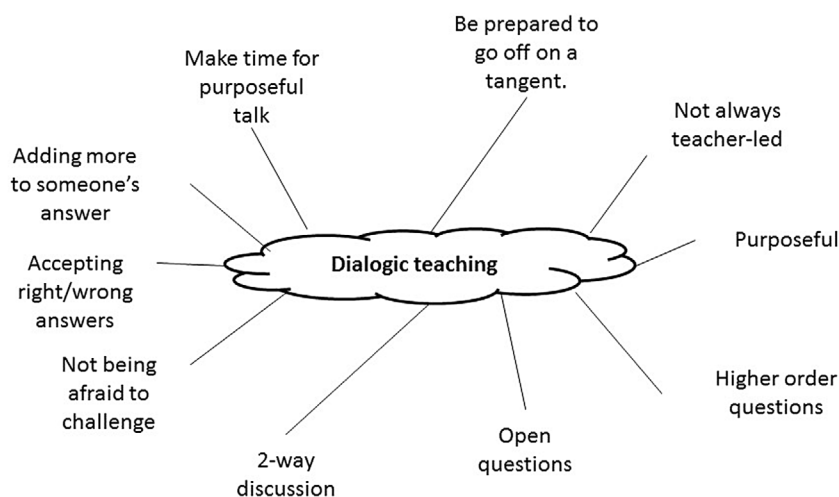
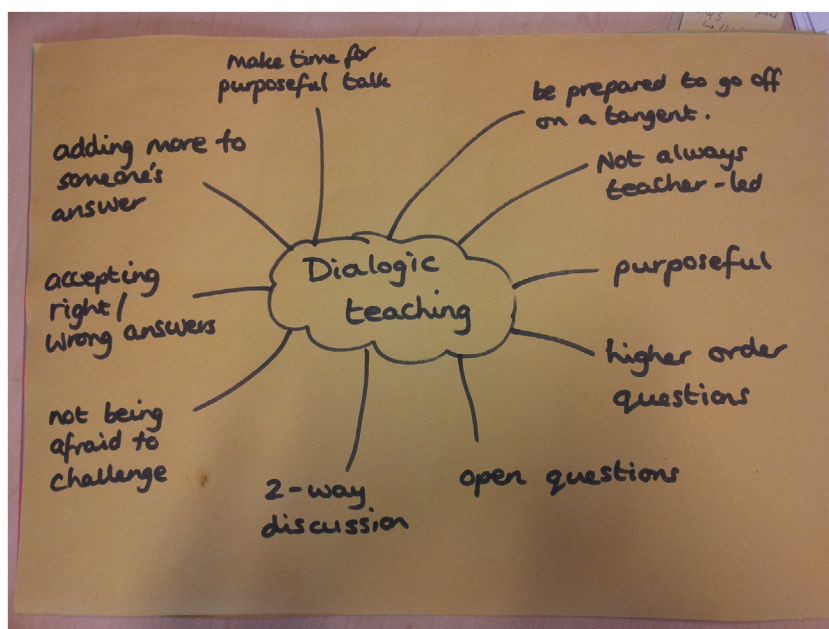
with the 30 who had already acknowledged on the survey that they were unclear about the distinction, this means that at least 48/68, or 71% of the survey sample, were initially unfamiliar with how dialogue, as distinct from talk, might be characterised. The true figure is likely to have been as high as 81% because only 19% (13/68) actually demonstrated evidence of medium/strong understanding through offering elaboration. Some examples of the teachers' understandings of classroom dialogue are presented in Table 3.

Furthermore, teachers' posters created at the first PPD workshop provided corroborating qualitative evidence for the survey findings, confirming that the distinction between classroom talk and classroom dialogue was not actually very clear. As seen in Figures 1 and 2 showing two groups' posters, both



HP_1.2.1

Figure 1. Group poster illustrating teacher understanding of classroom talk at the beginning of the first PPD workshop.



HP_1.2.2

Figure 2. Group poster illustrating teacher understanding of classroom dialogue/dialogic teaching at the beginning of the first PPD workshop.

concepts were characterised by similar features such as purposeful talk and asking questions. (Note: it was not possible to systematically analyse posters because they did not take a standardised form.)

Teachers' own use of dialogic teaching

Prior to their participation, 27 teachers stated that they sometimes used 'dialogic teaching' (fewer than the 38 who reported understanding of dialogue) and all of them offered recent examples when prompted (Question 9). Around half of these (13 or, again, only 19% of the whole survey sample) showed medium or strong understanding of dialogic teaching. The rest (14 teachers) showed weak understanding. Some illustrative examples included the answers presented in Table 4.

Table 4. Survey responses illustrating examples of dialogic teaching (Question 9^a).

Level	Response
Weak	Talking partners and feeding back? Children discussing a story before writing. Talking all aspects through without writing anything
Medium	Problem-solving in mathematics where each child has a role in the investigations so they each bring an aspect of the task to the group discussion Pupils annotating and contributing ideas to the IWB when studying character motivation/sharing the features of dramatic writing. Teacher as facilitator
Strong	Four groups with scenarios re ethical dilemmas. The groups discussed how these situations give rise to ethical debate and then introduced their scenario and the issues to the other groups. Each group was invited to develop the debate and discuss the issues, suggesting any solutions or further considerations, other potential views, etc. Pupils looking at variation in music. In groups they were discussing how music can be changed, varied. Pupils were able to build on each other's ideas and use of vocabulary

^aQuestion 9. If you consider that you sometimes use 'dialogic teaching', please give us a recent example, including the roles of the students and yourself in the dialogue.

Teachers' use of the IWB to support classroom dialogue

Thirty-one (46%) of participating teachers agreed or strongly agreed that they had used the IWB to support classroom dialogue, but only nine of them (13% of survey sample) demonstrated medium or strong understanding of dialogic teaching in this context through sharing concrete examples (Question 14). Some illustrative examples are presented in Table 5.

Category B: understanding of dialogic teaching after participation in the PPD programme

Semi-structured interviews carried out with 16 teachers and ambassadors after participation in the PPD programme indicated a number of perceived benefits. Some commented on how dialogue had taken place in the workshops themselves, with teachers feeling that they were learners and co-creators of knowledge through exploring the main features of a dialogic approach to teaching and learning. Interview comments particularly emphasised the value of having an opportunity for reflection and discussion with peers. They shared how they overcame 'reluctance' to use the IWB and became motivated to use the IWB more frequently for fostering dialogic teaching. What most teachers valued in the PPD programme was becoming 'tuned into' dialogic teaching; for example, '[I developed] a clear framework for how the dynamic of dialogue will take place in a lesson' (secondary school ambassador, English teacher).

Interviews also provided evidence of a shift in teachers' understanding of classroom dialogue (11 teachers), emphasising pivotal features such as building on each other's ideas, or a deepening of

Table 5. Survey responses illustrating teachers' understandings of IWB use for supporting classroom dialogue (Question 14^a).

Level	Response
Weak	I use open questions to stimulate modern foreign languages (MFL) dialogue Provides a focal point for the classroom dialogue. Involved more learners by catering for visual and kinaesthetic learners. Encourages all types of students to give standing at the front a go; [using IWB is] less scary or intimidating than simply standing up and talking
Medium	Questions, use of dice, use of images, reveal/colour coded – crack the code and discuss with partner It has been great for displaying pictures/videos to stimulate discussion, and for me to write directly on as pupils contribute ideas
Strong	As a stimulus – displaying a photograph that had been magnified. There was no right or wrong answer for the suggestions. I had told the children that I was not aware of the object. Using SMART [notebook software] I was able to annotate the picture and these ideas were developed and added to new lines of investigation. There was a real buzz in the room as the children challenged each other We use it to annotate any discussions and responses. We look back at previous lessons or discuss. We discuss things we have watched. Children will respond to the children watching on the IWB and tell them and show them if they don't agree

^aQuestion 14. I think I have used the IWB to support classroom dialogue.

Strongly disagree / Disagree / Neither disagree nor agree / Agree / Strongly agree.

If you agree or strongly agree, please describe how you did this in as much detail as you can.

their use of dialogic teaching where this approach was already established in the school (four teachers). As one teacher discussed:

So where [before] I thought ... maybe dialogue [was] perhaps open questions rather than closed questions, and perhaps the way I speak, I've now realised it's all about students building on each other's thoughts ... so that they can contrast their ideas, compare their own ideas ... and build on each other's. (Mathematics teacher)

Other examples from interviews illustrated a shift towards an understanding of classroom dialogue as a 'more layered approach than just classroom talk'; 'giving pupils independence, letting them be their own learners'; being 'much more pupil-led'; and 'thinking about how you structure what you're saying, so there's not just one answer'. So teachers were moving beyond the standard initiation–response–follow-up sequence (Sinclair and Coulthard 1975), as in the following example:

Dialogue, obviously ... refers to the building of ideas and coming back, so the more layered approach. So whereas classroom talk might be the students talking to each other, dialogue is more ongoing, more building a deeper understanding, if you like, through interrogating, I suppose, each other's talk. (Science teacher)

While the interviews included only a subset of our sample, there were no counterexamples detected in the interview or poster data in which teachers demonstrated weak understanding of dialogue or dialogic teaching. Moreover, one group of teachers spontaneously created a poster as part of the second activity at the second PPD workshop; comparison of their posters created at Workshops 1 and 2 provided corroborating evidence of a significant shift in understanding classroom dialogue. While this is admittedly only a single example, it presents quite a stark contrast between levels of sophistication of thinking on the two occasions. The posters clearly demonstrate that the teachers understood dialogue as 'creating conversation', 'open-ended' and 'guiding' at the beginning of the first workshop (Figure 3). Their poster from the second workshop (Figure 4) subsequently describes dialogic teaching/learning as a multi-layered and whole-school approach including teachers being 'ready to learn' and whole school policy 'embracing/encouraging dialogic teaching' and 'setting expectations of respect and trust'.

On the other hand, nearly half of the teachers from one of the hosting schools had previously been involved in research-led PPD on classroom dialogue. Hence their response to the first PPD workshop was different from other schools; however, they showed a similar appreciation of the second workshop to others:

The second session I found much more satisfactory, because it made me go back and focus on things and look at things, and [I learned about] things like the scrolling banners. (Years 7/8 teacher)

Whilst teachers from this school could not demonstrate the same level of shift in their use of dialogic teaching supported by the IWB, even here both teachers and ambassadors emphasised how valuable it was to 'refresh' their knowledge and to 'remind' them of some of the IWB features that they could use in order to foster dialogic teaching:

... it made them look at things with a fresh eye. (Middle school ambassador 1, Years 7/8 teacher)

Category C: concrete examples of dialogic teaching supported by the IWB

I'd done a little bit of dialogic learning before and it was a year-long course and I think teachers had to upload things. That wasn't as good as the PPD programme this time ... because I quite liked that it opened some ideas, have some time in between to try some things, and then meet and discuss how it went, and that was quite powerful. (Mathematics teacher)

This quote sums up participants' appreciation of a critical feature of the PPD model: interspersing face-to-face workshops including exposure to and peer discussion of new ideas with classroom trialling of new approaches. This section presents evidence for the impact of that process on teachers' subsequent practices. Before their participation in the PPD programme, 93% of participating teachers agreed or strongly agreed that they had been using the IWB mainly for displaying their PowerPoint presentations or other resources, often linked to websites. Afterwards they reported experiences of using the IWB for fostering dialogic teaching. The 59 teachers who participated in both workshops

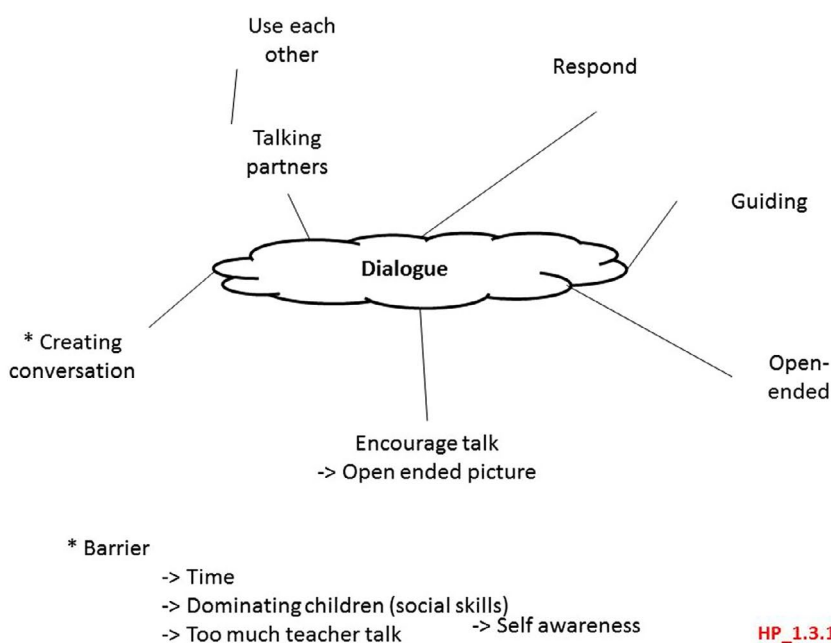


Figure 3. Group poster demonstrating teacher understanding of dialogic teaching at the beginning of the first PPD workshop.

were asked to store the materials they developed between the first and second PPD workshops, and subsequently either on Google Drive or Dropbox. As a result, 37 teachers contributed 116 notebook flipcharts, 12 ActiveInspire flipcharts, two audio files, one video file, four Word documents, four pdf files and one PowerPoint file. These new resources spanned a range of curriculum areas, indicating the likelihood of teachers embedding new approaches across their teaching practices. They have been

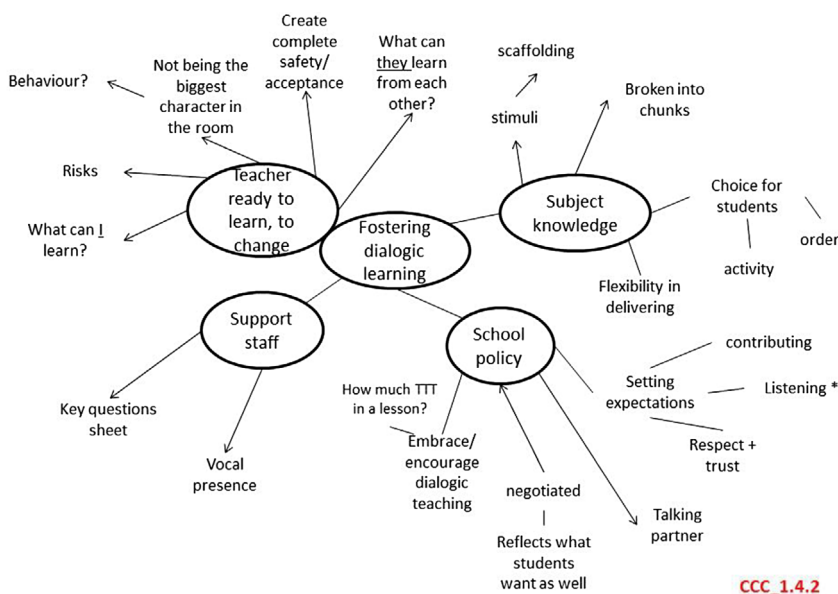
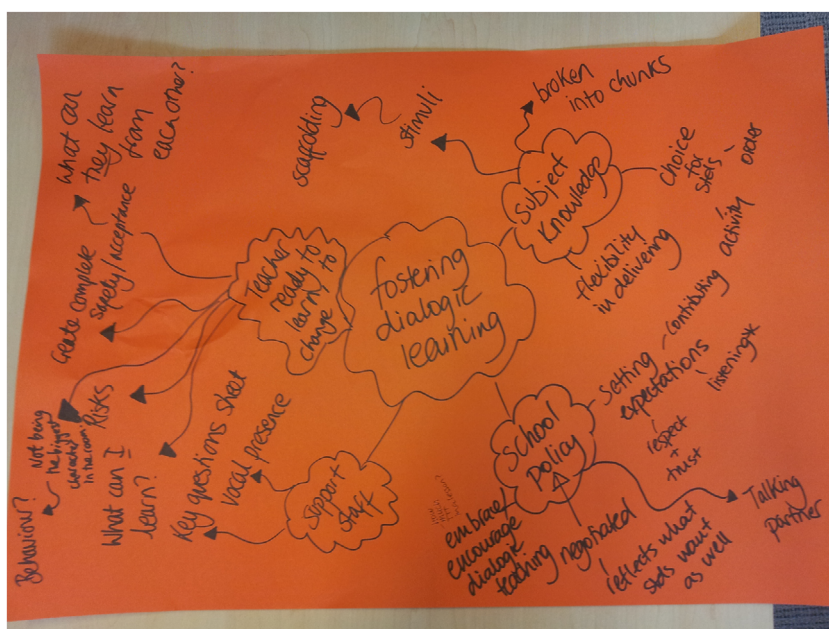


Figure 4. Group poster demonstrating teachers' holistic understanding of dialogic teaching at the second PPD workshop.

made available to practitioners in other schools via our project website. The contributed resources included the following.

Simple picture stimuli

One KS1 teacher contributed images used to look at beach holidays over time, describing how the children 'suggested things and they were explaining their ideas why and I wasn't saying anything'. Another Year 1 teacher contributed a single image of a cottage in a wood which was used to stimulate both creative thinking ('Who might live in this house?') and dialogue, including across lessons:

I tried to get as many different answers as possible. So it was just one still image that just opened up a lot of conversation, different opinions, ideas and I was able to come back to the same image a couple of days later, and they remembered a lot of what they'd said and had new ideas expanded by what they had heard from others last time.

Annotation, the use of recording and revisiting

One Year 2 teacher asked children:

to comment on the painting of the Mona Lisa and annotate and, actually, it was really interesting the way they offered completely opposite views, and I didn't really need to explain to them, they'd just note and accept each other's views, or challenged.

Teachers used the video and audio-recording facility of the board for many reasons, finding them 'powerful': 'You can do that live in the classroom, and get them to come and communicate what it was, and then what they want to say and then play it back with their blessing in another session' (secondary school teacher).

The significant point here is that the contributed resources were either created individually by the teacher or co-constructed with their students (Warwick and Kershner 2008) to stimulate dialogic interaction in classrooms or as a result of such interaction; thus the character of these resources was very different from those that most of the teachers were devising prior to the PPD programme, because the pedagogic intentions of the teachers had shifted. These resources show evidence for the creation of multimodal, mediating artefacts for learning (such as combinations of text, images and sounds; Jewitt 2006), the flexible use of which has the potential to enable dialogue, both between the teacher and students and between students themselves. Other items contributed demonstrate the potential of constantly evolving resources that can constitute interim records of activity and act as supportive devices for learners' emerging thinking over time, rather than finished products of dialogue (Mercer 2008, Hennessy 2011). The resources illustrate that IWB use can potentially support rich forms of dialogue, highlighting differences between perspectives and making evolving ideas and reasoning processes more explicit.

All teachers shared their examples at the second workshop sessions, demonstrating a high level of understanding of dialogic teaching, which is evidenced through our audio recordings of their discussions. Some were very explicit about the impact of the programme at this point:

At the beginning I thought, okay, it's just, maybe just an open-ended discussion, but now I kind of see dialogic teaching as more building knowledge together. (Year 1 teacher)

It's not just a picture on a screen, it's not for you just to talk about and involve the children. (Year 3 teacher)

Figure 5, a freeze-frame prompt, shows part of a cartoon about the animation of a piano; it was used at particular points in the story to prompt students to decide 'what they thought each character was thinking in each case, but it was okay to think something different to your partner' (Year 5 teacher). Writing some of these ideas so that they were associated with the characters stimulated a discussion about contrasting ideas, with the students providing reasons for their interpretations and working towards agreement (Mercer and Littleton 2007).

Figure 6 illustrates an innovative lesson on Venn diagrams, in which the children first worked in groups outdoors using physical hoops as a basis for deciding how they would categorise different types of shoe. During this part of the lesson 'the children spent ages, actually, discussing, agreeing and disagreeing, deciding which shoe should go where ... changing their minds ... and we talked about the categories, the colour, the design of the shoe, male or female ...' (Year 3 teacher). The IWB was then used to draw the ideas of the class together around a similar problem; the teacher reported that there was 'a lot of talking, discussing, building on each other's ideas and a lot of people agreeing or disagreeing with each other ... and it was very cooperative, collaborative'. Thus, using the IWB as a stimulus for dialogic interaction does not require an 'all singing, all dancing' command of the technology by the teacher; simple IWB resources can be powerful stimuli for classroom dialogue (Warwick *et al.* 2010).

It is worth considering briefly here how such activities 'fit' with the general ethos of the classroom. In a dialogic classroom there is a shared understanding of the talk rules for teacher-student and

Tuesday, 10th June

I can track thoughts and

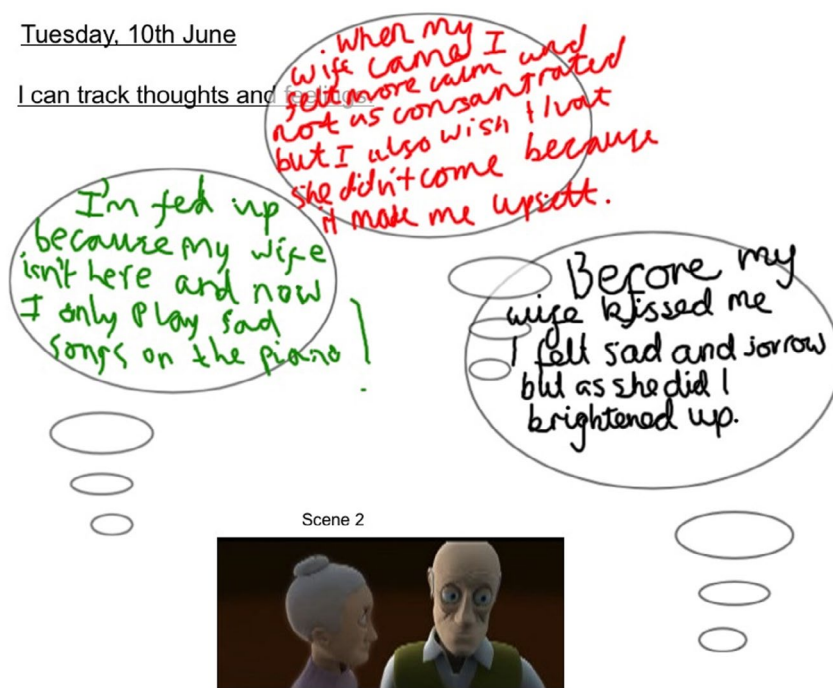


Figure 5. Use of photographic stimuli as a dialogue prompt.

student–student dialogue (Mercer and Littleton 2007). This was often emphasised by the teachers in this study describing the joint creation with their students of ‘ground rules for talk’ (Dawes 2000). Use of such protocols in conjunction with specific activities helps to underline the teacher expectations for dialogue during the activities and explicitly encourages a more general open expression of ideas, without fear of censure. An example from one Year 5 classroom can be seen in Figure 7.

Two Year 5 follow-up lesson observations were carried out 10 weeks after this study, during the following school year: a science lesson on dissolving and an English lesson on the poem *The Jabberwocky* by Lewis Carroll. Field notes illustrate that these teachers continued to create a supportive ethos for dialogue, through the following:

Posing open questions:

- ‘What are your ideas about what is happening in the poem?’
- ‘How can you compare coffee with sugar and salt?’

Constructing shared interpretations and new knowledge:

- Teacher collected ideas on what ‘bandersnatch’ might mean, eliciting, for example, ‘a creature which is bendy and when it snatches you it pings back’ or ‘an evil monster or a beast that eats people’. Teacher’s responses accepted pupils’ ideas and praised their attempts.
- Teacher asked for help in pronouncing one of the nonsense words – ‘tulgy’; the pupils voted for two different pronunciations and when one won overwhelmingly, the teacher concurred.
- One group shared their result that coffee is more soluble than sugar, which was contrary to the teacher’s trial at home; she concluded ‘That’s interesting you got different results ... but that’s science’.

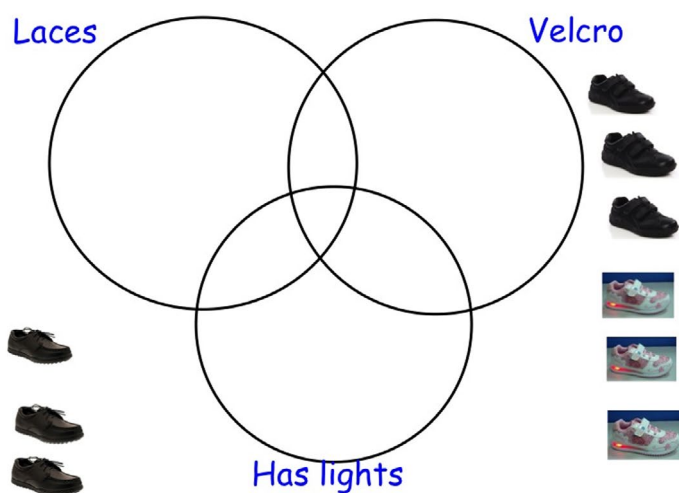


Figure 6. Combining hands-on and IWB-supported activities.

Encouraging students to articulate and justify their own points of view:

- Teacher stated ‘There are no wrong answers ... you can say whatever you like.’ Once ‘enchanted’ was written on the IWB by a pupil, teacher asked the class to explain why they thought that might be a good word to describe a sword.
- Towards the end of the lesson a boy argued that sand cannot dissolve because the beach is there. Teacher highlighted to the class that he had made a link to real-life experience.

Encouraging students to actively comment and build on each other’s ideas:

- Teacher read the whole poem; one pupil noted that it was about the creature they saw in the photograph at the beginning of the lesson. Another pupil extended that idea by suggesting that the poem was about a boy cutting off the dragon/creature’s head.

By integrating such strategies into their general teaching, and by emphasising ground rules for talk in relation to activities with and without the IWB, these teachers were constructing a dialogic classroom ethos. These few examples illustrate just some of the ways in which teachers rose to the challenge

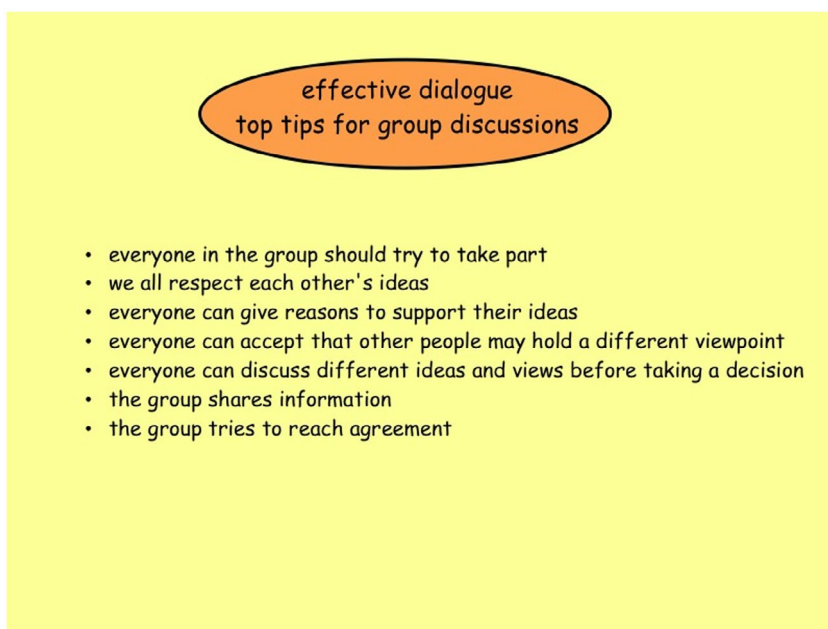


Figure 7. Ground rules for talk in a Year 5 classroom.

posed of 'designing for dialogue', sourcing evocative images, cartoons, mathematical representations and other media. They planned their lesson activities to support dialogic interaction, considering the ways in which their design of the IWB resources would help to stimulate reasoning and cumulative knowledge-building, require possibility thinking and justification, and encourage children to work towards consensus.

Category D: workability, challenges, sustainability, dissemination and future plans

In this section we critically reflect on the potential for spreading the influence of the ambassador-led PPD model adopted, within participating schools and beyond, which constitutes the final overarching theme emerging from our interview data. The data here include professional learning benefits and challenges for ambassadors, especially in relation to sustainability. The reports of future plans for continuing the practice of dialogic teaching, supported by the IWB, describe teachers' and ambassadors' ideas and strategies for sustaining and expanding the newly developed dialogic approaches.

Dissemination of the acquired knowledge/skills

When ambassadors were asked how they were planning to widen the project's impact, they mentioned a range of strategies, including 'get[ting] some of those things written into the schemes of work as suggested activities' (KS3 teacher); catch-up sessions requested by colleagues; sharing new practices and resources with incoming teachers; dissemination at TeachMeets involving teachers from different schools in the region; and introducing dialogic teaching supported by the IWB as initial teacher training students' weekly targets. One teacher (Year 4 teacher/science coordinator), who was starting her Masters degree, reported that she had become motivated to specialise in dialogic teaching for her research. Her school's ambassador saw this as an opportunity for this teacher to bring further expertise back into her school.

The most widespread suggestion for dissemination was a stated plan for wider school professional development activities to share the new practices and approaches, either including dialogic teaching

within an ongoing PPD programme or devising new sessions/establishing new groups. One mathematics teacher had been asked to lead a session in a training carousel. An ambassador mentioned that her peer support role had been ‘enshrined’ by the head teacher within the wider school development plan and her own weekly workplan:

... so that I can continue, hopefully, to support people, to help them make their own resources, to make my own and continue to improve my practice ... So, certainly, I think I’m going to continue to be an ambassador ... [ensuring] that everybody is still doing the things that we discussed at the sessions. (Middle school ambassador 2, English teacher)

Cross-curricular initiatives had emerged through working with colleagues across departments in the workshops:

I thought, actually, that was a great opportunity to kill two birds with one stone, because you’ve got the ... adaptation of the interdependence aspects of the biology in there, but you’ve also got the English aspects in there. So you can light up not only the kids that are interested in science ... but also the ones that are interested in art. (KS3 teacher)

One science teacher described how she and a colleague moved beyond trying out ideas in their own teaching to working with colleagues in the mathematics and English departments to adapt a dialogic approach to tackle underachievement, using the IWB resources to engage students from quite disadvantaged backgrounds:

... these ideas are all gelling together now, they’re all coming to critical mass and we are now thinking, right, we could do something similar for these students ... to try and hook them in early in Year 7, so that we’re getting them really interested in their subjects ... So we’re going to try and see if we can develop ... some more simpler images than the ones I’ve been looking at that’ll be suitable for those particular types of students ... (KS3 teacher)

These school-level development activities should serve to sustain the influence of the PPD programme. The factors affecting sustainability are explored in the following section.

Sustainability and challenges

A limitation of the ESRC Impact Acceleration programme is its relatively short-term funding of projects, making it difficult to assess long-term sustainability. Nevertheless, in addition to the dissemination measures already outlined, teachers and ambassadors offered strategies for sustainability in their settings. These included having an ambassador as a local coordinator in the school in the future: ‘the role that [colleague] has, is crucial because that person will then keep the ball rolling’ (science teacher). Another suggested strategy referred to integrating dialogic teaching supported by the IWB as a criterion for an ‘outstanding’ lesson; this has now been implemented and, two years on, trainee teachers in the school concerned are being observed and assessed accordingly.

Moreover it was very encouraging to hear participants assert in follow-up interviews that the programme had had a lasting impact on their practice; this was self-evidently corroborated by the illustrations in the previous section. One secondary school ambassador (English teacher) claimed three weeks after the project completed that ‘even following only the two sessions, it’s had an impact in, I can say with all honesty, every lesson that I’ve taught subsequently’.

The interviews additionally provided data on how ambassadors felt they had benefited professionally from taking on their pivotal role in the project. Some responses focused on flexible co-design of the PPD workshops:

... it was nice to have to host something like a workshop for the first time, so personally specifically that was a new experience ... And you [researcher] were open to – into my ideas for questions and activities we could do, so that was nice to be able to think about that. (Secondary school ambassador, English teacher)

It was quite easy to develop bits and pieces for [other ambassador] and I to think about what it was that we wanted to say, and then obviously work with the information that you’d given us. That seemed to be dovetailed quite nicely and be quite fluid, and it was a lot of good stuff in place that we could work with. (Middle school ambassador, Year 8 teacher)

Ambassadors highlighted the benefits of ‘taking more of a leadership role’ (primary school ambassador, Year 5 teacher) and, in one case, a growing awareness of adult learning processes and its impact on colleagues’ development that persisted beyond the project:

I really enjoyed going through in the preparation session and you taught me about the different kinds of adult learners, and that was really helpful. It’s stuck with me in terms of thinking about presenting and discussing, and working at all times with teachers in the department. So the other day we were just doing some collaborative lesson planning, and then it helped me negotiate my dialogue with them ... And it was nice to ... see it concretely demonstrated in the workshop ... actually tailoring to their needs that they then became like the best and brightest, which was really interesting. (Secondary school ambassador, English teacher)

Ambassadors also shared some of the challenges they faced during their participation in the PPD programme. The first was time and daily work pressure. This challenge remains the domain of each school and individuals’ time-management strategies, although careful attention to timing of workshops – both within the school year and in the school day – is necessary to maximise attendance; twilight sessions (after 4:00 pm) were the preferred model in most schools, although a minority preferred shorter, more regular lunchtime sessions. One constructive suggestion made was to schedule more time between workshops.

While all ambassadors successfully carried out all of the PPD programme organisation-related activities, coordination across schools in large clusters was another reported challenge. Travel from neighbouring schools was time consuming and sometimes posed a deterrent; workshop attendees understandably tended to derive predominantly from the host school. This has significant implications for any cluster-based PPD model. Finally, more technical support may be beneficial; not all teachers were confident users of the IWB technology.

Despite the logistical challenges faced, participants were very satisfied with the PPD model overall. They described the PPD workshops as both reflective and practical, clearly articulating that they found them clear, concise, well organised, enjoyable and effective. Teachers particularly emphasised how important and valuable it was to see and discuss video examples of dialogic teaching practice. Many teachers and ambassadors expressed their wish for continuation of the PPD programme; that is, a third workshop and lesson observations both by researchers and by peers. This raises the wider question for school leaders and policy-makers of what support schools need to sustain and enhance PPD models targeted at making classroom practices with technology more dialogic and effective.

Conclusions

The PPD model – based on research-informed, cluster-based, ambassador-led workshops involving video-stimulated discussions and testing of the adapted and newly developed IWB-based teaching materials in between the workshops – proved to be successful and clearly appreciated by teachers. The model built upon contemporary approaches to PPD through collaborative inquiry, taking it in new directions and testing it in a novel context of application. The project’s overall aim was to investigate the influence of a PPD programme upon teachers’ understanding of dialogue and use of dialogic approaches to teaching with the IWB. Our baseline data highlighted the need: only 19% of participants initially demonstrated a medium or strong understanding of what dialogue and dialogic teaching are, and even fewer (13%) were able to provide concrete examples of IWB use that demonstrated medium or strong understanding of dialogic teaching. Yet all teachers who shared their examples at the second workshop, as well as all 16 teachers and ambassadors who were interviewed, subsequently demonstrated a high level of understanding.

It was particularly pleasing to see shifts in thinking with respect to an understanding of dialogue and dialogic pedagogy actually leading to shifts in the use of the IWB to implement a more dialogic approach. While many PPD evaluations focus on participant experiences, perceptions or changes in thinking, we considered it important to validate self-reports by capturing concrete examples of what teachers produced. Participants shared numerous new practices with peers and these have all been made available to other practitioners. Rather than seeing the IWB as primarily a presentation tool,

as many teachers had done beforehand, the discussions around the nature of classroom dialogue did genuinely seem to have developed understanding of the multimodal possibilities of the tool in relation to key elements of a dialogic pedagogy. The programme asked teachers to ‘design for dialogue’ and they rose to the challenge by devising technology-supported activities that built in opportunities for exploring and building on others’ ideas. Thus, we found the IWB being used to promote collaborative meaning-making (Mortimer and Scott 2003) and to develop opportunities for individual and collective reasoning to be articulated (Mercer and Littleton 2007). We have examples of the IWB being used as a central stimulus to teachers’ open-ended, higher-order questioning, which in turn encouraged pupils to articulate and justify their own points of view. Use of the IWB as a tool for the development of a dialogic pedagogy, through teachers and learners constructing digital knowledge artefacts together (Hennessy 2011), therefore seems to have moved from a possibility to a reality for many of our participants.

The pivotal mechanisms for this shift included the combination of the external stimulus of the video and other multimedia PPD materials provided (Sherin 2007); the opportunities to engage in collaborative learning, critical reflection, dialogue and inquiry with like-minded peers; and the close connection to daily classroom practice through trialling and refinement of new approaches and ideas (Cordingley *et al.* 2003, Twining *et al.* 2013). Both teachers and ambassadors considered that they had experienced a dialogic approach to their own professional learning in the workshops. Through these mechanisms, participating teachers came to harness the distinctive affordances of the IWB technology to create space for learning through dialogue (Gillen *et al.* 2006, Jewitt 2006, Warwick *et al.* 2010). They were keen to continue developing their practice in new directions after the research project had ended, including wider school development activities.

Finally, the role of the ambassadors – as both champions and coordinators – proved central in ensuring support for, and smooth running of, the programme within each cluster. Challenges they faced were mainly logistical, and hopefully surmountable in future implementations; nonetheless, including more representatives from neighbouring schools at workshops, and hence cross-fertilisation, remains challenging in the face of teachers’ current working conditions. Ambassadors developed leadership skills through jointly designing and running the PPD workshops. Broadly, therefore, we are confident that the PPD model, in addition to stimulating dialogic pedagogy in relation to the use of the IWB, managed to engage school clusters to some degree, thus achieving ‘critical mass’, consistent approaches and local sharing of practices. It maximised dissemination, sustainability and school ownership by recruiting school-based ambassadors. All six ambassadors plan to be engaged in further dissemination of the project.

These conclusions have clear messages for school leaders and policy-makers interested in implementing a school-based, ambassador-led PPD programme. To scale the programme in new contexts at low cost, we propose a semi-supported model where the PPD workshop materials are made available, and schools themselves organise workshops with their own ambassadors. In future research the measurement of impact could be extended over longer time periods and enhanced through conducting surveys and lesson observations before and after participation in the PPD programme. However, the fact that counterexamples to pedagogic change did not emerge is most encouraging. Likewise, triangulation and validation through concrete evidence of changing practices, along with high inter-coder reliability, indicate that trustworthiness was high. We consider that the iterative design and flexible adaptation by facilitators and researchers to local needs and concerns was an important factor in sustaining the learning by teachers and ambassadors that took place. Penuel *et al.* (2011) argue that positioning practitioners as co-designers can facilitate the development of usable tools which educators (ideally within and beyond the context) are willing to adopt. While our own evidence of long-term sustainability is limited by the timescale of our project, the encouraging outcomes make a sustainable and scalable model potentially viable.

Finally, it is notable that many schools are now introducing tablets and other similar mobile devices to support teaching and learning; participating schools which had invested in these devices were encouraged to apply new dialogic approaches to their use, and did so with considerable success.

Future development of the programme and collation of teaching resources could explicitly encompass these new technologies, particularly in conjunction with use of the IWB or new interactive flat screen display panels that are increasingly replacing IWBs. Again, it is the pedagogy that is paramount, not the technology, although a large interactive screen of either type does offer very specific affordances for supporting whole class dialogue, as discussed earlier. It is essential that policy-makers avoid the pitfalls of previous technology initiatives that marginalised pedagogy-focused PPD and offer sufficient support to teachers in using emerging technologies to promote more effective classroom practice.

Notes

1. Becta was a non-departmental public body funded by the Department for Education and its predecessor departments in the United Kingdom. It supported schools in all aspects of technology use from 1998 to 2011, when its activities were discontinued.
2. An overview of the contents of the printed and online resources, and links to the latter, can be found online: <http://tinyurl.com/OUPIWB>.
3. This is available online: <http://dialogueiwb.educ.cam.ac.uk/resources/resourcebank/> [Accessed 21 February 2017].
4. A Key Stage (KS) refers to successive year groups in the UK education system: KS1 covers Reception and Years 1 and 2 (ages four to seven); KS2 covers Years 3–6 (ages seven to 11); KS3 covers Years 7–9 (ages 11–14); and KS4 covers Years 10 and 11 (ages 14–16).
5. Detailed outlines of the workshops including hyperlinks to the video clips shown are available online: <http://dialogueiwb.educ.cam.ac.uk/evaluate/> [Accessed 22 February 2017].
6. See <https://www.bera.ac.uk/researchers-resources/publications/ethical-guidelines-for-educational-research-2011> [Accessed 21 February 2017].
7. See <http://dialogueiwb.educ.cam.ac.uk/evaluate/> [Accessed 22 February 2017].

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